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(54) Title: ADJUVANT FOR A HERBICIDAL COMPOSITION

(57) Abstract: An adjuvant composition for use with a herbicide including: one or more agriculturally acceptable salts; a surfactant component including an ammonium salt of an ethoxylated alcohol phosphate ester; and an amphoteric surfactant.

Adjuvant For A Herbicidal Composition

The present invention relates to an adjuvant for a herbicide to a herbicidal composition containing the adjuvant and to a method of using the composition.

5

It is known to use adjuvants with herbicides. Adjuvants are substances in a herbicide formulation or added to the formulation prior to application which improve herbicidal activity or application characteristics.

- 10 The invention will be described with reference to a particularly preferred herbicide, glyphosate, but it will be understood that the adjuvant may be used with other herbicides if desired.

- 15 N-phosphonomethylglycine also known by its common name glyphosate, is an important broad spectrum herbicide which is widely used to control a wide range of weeds. Glyphosate is an acid which is relatively insoluble in water and it is typically formulated as a salt particularly the isopropylamine salt which is highly water soluble.

- 20 Glyphosate is used in a range of forms. Aqueous concentrates are widely used by farmers. The concentrates are diluted shortly before application. Glyphosate is also available in a water soluble granule formulation. The granules are dissolved in water prior to application.

- 25 Glyphosate is normally formulated with a surfactant and other additives. The surfactants used in the formulation are frequently a fatty amine or derivative such as an ethoxylated fatty amine or quaternary ammonium compound. Another class of emulsifier used with glyphosate are the alkylpolysaccharides. Such adjuvants have been found to increase significantly the activity of glyphosate.

30

Spray tank adjuvants are also commonly used. This type of adjuvant is added to the spray tank used to prepare a dilute solution of herbicide from the concentrate.

Surfactants such as fatty amine ethoxylates and alkylpolysaccharides have also been used for this purpose.

5 Trifluralin is a herbicide of the dinitroaniline group, and is one of the most commercially successful herbicides and is widely used in pre-sowing application to soil in many important crops. It is effective against both grassy weeds and broad-leaved weed. Atrazine is a herbicide of the triazine group, and is also used as a herbicide at the time of sowing crops, particularly canola.

10 It is sometimes desirable to use other herbicides in combination with glyphosate. In order to kill the maximum number of weeds the timing for application of glyphosate needs to be left until shortly before sowing. This also coincides with the optimal timing for triazine herbicides such as atrazine and dinitroaniline herbicides such as trifluralin. If glyphosate and atrazine or trifluralin could be
15 effectively applied together this has the potential to allow better knockdown. It would also allow farmers to sow a crop at the optimal time to maximise yield and reduce competition from weeds. Tank mixing of the herbicides would reduce the labour and cost associated with separate applications which are currently required.

20

Existing formulations of glyphosate are generally incompatible with trifluralin and atrazine resulting in phase separation when the herbicide compositions are combined. Also their combined use has been found to seriously reduce the efficacy of the compositions.

25

Another difficulty of herbicide formulation is stability in hard water. This is, of course, a particular problem in many rural areas where water quality is poor. For many herbicide formulations the components separate in hard water and are ineffective.

30

It is an aspect of the invention to provide an adjuvant which will allow herbicides such as glyphosate to be used in a wide range of formulations and with other herbicide groups such as the dinitroaniline and triazine groups.

In accordance with the invention we provide an adjuvant composition for use with a herbicide including:

- one or more agriculturally acceptable salts such as ammonium sulphate,
5 alkylammonium sulphate or mixture thereof;
a surfactant component including an ammonium salt of an ethoxylated alcohol phosphate ester and
an amphoteric surfactant.
- 10 The alkylammonium sulphate when present may be a mono-, di- or trialkyl-ammonium sulphate. The alkyl group or groups preferably contain up to six carbon atoms, more preferably up to 4 carbon atoms and most preferably are isopropyl. Ammonium sulphate is preferably present.
- 15 The amphoteric surfactant is preferably a phospholipid with an acidic buffer, particularly propionic acid.

The preferred concentration of components in the adjuvant are as follows:

- from 5 to 30% w/w of ammonium sulphate, alkylammonium sulphate or
20 mixture thereof;
from 0 to 25% w/w, preferably from 0.5 to 25% w/w of ammonium salt of an ethoxylated alcohol phosphate ester and;
from 0.5 to 10% w/w of amphoteric surfactant which is preferably a phospholipid.
- 25 The adjuvant of the invention may be used as a tank mix type adjuvant or may be the adjuvant component of a herbicide formulation such as glyphosate, a dinitroaniline herbicide, a triazine herbicide, a cyclohexane dione herbicide, a phenoxy herbicide, an imidazolinone herbicide, a pyridyloxyphenoxy herbicide or
30 mixture thereof.

Accordingly the invention further provides a herbicidal composition containing an effective amount of one or more herbicides and an adjuvant component including

a surfactant component including an ammonium salt of an ethoxylated phosphate ester and an amphoteric surfactant and

an agriculturally acceptable inorganic salt preferably ammonium sulphate or an alkyl ammonium sulphate.

5

Preferably the herbicide is glyphosate, trifluralin or atrazine and more preferably it is glyphosate or mixture of glyphosate with at least one of trifluralin and atrazine.

10 Glyphosate when present, may be in the form of the isopropyl amine salt, the ammonium salt, sodium salt or other suitable glyphosate salt. We have found that there are particular advantages if glyphosate is used in the form of a mixture of isopropylamine and mono-ammonium salts. As disclosed in our copending Australian Provisional Patent Application No. PQ3393 (13 October 1999) it is particularly preferred that the ratio of isopropylamine salt to ammonium salt is in
15 the range of from 70:30 to 97:3 and more preferably from 75:25 to 95:5.

The ethoxylated phosphate ester may be present in an amount of up to 10% by weight of herbicidal composition but preferably it is from 0.1 to 5% by weight of the herbicidal composition.

20

The adjuvant composition of the invention may, if desired, contain other additives such as further surfactants, crop oils, antifoam agents, further inorganic salts, nitrogenous compounds, dyes or mixtures thereof.

25 Examples of surfactants which may be useful include alkanolamides, betaine derivatives, ethoxylated propoxylated block copolymers, glycerol esters, glycol esters, imidazolines and imidazoline derivatives, lanolin derivatives, lecithin derivatives, tertiary or quaternary polyoxyalkylene alkylamines, polyoxyalkylene and non-polyoxyalkylene alkylamine oxides, polyoxyalkylene alkylethers,
30 polyoxyalkylene alkylarylethers, polyoxyalkylene alkylesters, alkoxylated and non-alkoxylated sorbitan esters, alkyl glycosides, alkyl polyglycosides, sucrose esters, sucrose glycerides, alkyl sulphates or phosphates, olefin sulfonates, alkylaryl sulfonates, polyoxyalkylene alkylether sulphates or phosphates, sulfosuccinate

derivatives, sulfosuccinamates, taurates, sulphates and sulfonates of oils, fatty acids, alcohols, alkoxyated alcohols, fatty esters and aromatic derivatives and mixtures thereof.

- 5 Examples of acceptable inorganic salts include ammonium sulphate, ammonium nitrate, potassium phosphate, tetrapotassium pyrophosphate, sodium bisulphate, sodium sulphate, ammonium bicarbonate.

- 10 Examples of crop oils which may be present in the composition include paraffinic oils, vegetable oils and vegetable oil derivatives such as vegetable oils trans esterified with lower alkanols. The crop oil may be used in an amount of up to 25% by weight of the adjuvant.

- 15 In a preferred embodiment the adjuvant of the invention is free of herbicidal active agents and is for use as an additive to a herbicide composition prior to application. This general type of adjuvant is known as a tank mix adjuvant and may be packaged and sold separately or may be in the form of a kit comprising separate herbicidal composition and adjuvant for use in admixture and with added water. The adjuvant composition may be sold in a form ready to dilute with a
20 herbicide composition and water. The composition may be used with a range of +herbicides such as those listed above but is particularly suited to use with glyphosate, dinitroaniline herbicides, triazine herbicides or mixtures thereof.

- 25 The adjuvant of the invention may be packaged in a kit with a herbicide composition such that when approximately equal volumes of adjuvant and herbicide are mixed they provide a weight ratio of herbicide to ethoxylated alcohol phosphate ester of from 150:1 to 3:1. This ratio is particularly suitable when the herbicide is glyphosate (in which case the weight ratio is determined on the basis of glyphosate acid).

30

In a further aspect the invention provides a method of eradicating weeds including mixing a herbicide formulation with the above described adjuvant.

The present invention will now be more fully described with reference to the following examples. It should be understood, however, that the description following is illustrative only and should not be taken in any way as a restriction on the generality of the invention described above. Where the concentration of glyphosate is expressed in grams per litre (g/L) it is understood that this refers to grams of glyphosate as the acid form per litre of composition.

Example 1

- 10 An adjuvant formulation of the invention for use with a glyphosate composition was prepared by combining the following components in the relative quantities specified:

RAW MATERIAL	QUANTITY KG/L
Ammonium Sulphate	0.2550
RHODOFAC ARB-70	0.1786
Ammonia (28%w/w)	0.0510
Li-700	0.0455
Process Water	0.6320
Specific Gravity	1.162

15

RHODOFAC ARB-70 sold by Rhodia is an ethoxylated alcohol phosphate ester and forms the ammonium salt in solution.

Li-700 from Loveland Industries Inc, U.S.A. is a mixture of soyal phospholipids and propionic acid.

20

The combination of components in the adjuvant composition generally allows for better physical compatibility and improved efficacy even in hard water.

25

Example 2

A glyphosate composition suitable for use with an adjuvant in accordance with Example 1 was prepared by combining the following components in the relative quantities specified:

RAW MATERIAL	Quantity Kg/L
*Glyphosate Acid (Wetcake)	0.6287
2-Propanamine 100% w/w	0.1864
Ammonia (28% w/w)	0.0213
GERONOL CF/AR	0.0266
LUCONYL Green FK872	0.001
Process Water	0.3710
Specific Gravity	1.2350

*The glyphosate acid wetcake contained approximately 86% w/w glyphosate based on glyphosate acid (11% w/w water). The purity of the glyphosate was 96.5% on a dry basis.

The composition, which contains 540 g/L glyphosate could readily be delivered using standard pumps used by farmers and was stable in solution at temperatures of 5°C for extended periods.

GERONOL CF/AR surfactant sold by Rhodia is the 2-propanamine salt of ethoxylated alcohol phosphate ester.

The results are shown in the attached drawings.

Referring to the drawings:

Figure 1 is a bar chart comparing the relative performance of a 1:1 volume mixture of the herbicidal composition of Example 2 and the adjuvant of Example 1 with a prior art herbicidal composition/adjuvant mixture at the recommended ratio

Figure 2 is a bar chart comparing the low use rate efficiency of a 1:1 mixture (by volume) of the adjuvant/composition formulation of Example 1/Example 2 with the comparative adjuvant/glyphosate combination of the prior art (in the recommended mixing ratio) at the rate of grams of active ingredient per hectare.

Figure 3 is a bar chart comparing the weed control performance of the composition of the Example 2 when used with the adjuvant of Example 1 in a 1:1 volume ratio with the prior art composition when used with the recommended surfactant adjuvant.

Figure 4 is a bar chart comparing the performance of the adjuvant/glyphosate combination of Examples 1 and 2 (1:1 volumetric ratio) with the prior art adjuvant/glyphosate combination when used together with TRIFLUR trifluralin formulation.

Figure 5 is a chart comparing the performance of the adjuvant/glyphosate combination of Examples 1 and Example 2 (1:1 volumetric ratio) with the prior art adjuvant/glyphosate combination when each are used with NUTRAZINE brand atrazine formulation.

Figure 1 shows the performance of the prior art herbicidal adjuvant/composition mixture is significantly reduced in hard water whereas there is little or no reduction in the efficiency of the composition of Example 1/Example 2 at the same use rate (gai/ha). The comparison was carried out using soft mixing water (225 ppm) and hard mixing water (1000 ppm). We found that the adjuvant of the invention significantly improves herbicidal performance in hard water when the rate of application was 450g glyphosate acid equivalent per hectare.

30

Referring to Figure 2 it can be seen that despite lower use rates placing more pressure on the surfactant system the adjuvant/composition combination of the invention performs successfully even at low rates. We found higher efficacy thus

prior art formulations of 490g/L glyphosate at equivalent low usage rates (gai/ha= grams active ingredient per hectare). As shown in Figure 3 we also found good activity on broadleaf weeds such as cape weed or clover at equivalent rates. This is a weakness of many prior art formulations.

5

Glyphosate products are frequently sprayed in conjunction with other pesticides but incompatibility with other pesticides is sometimes an important issue which can arise from physical effects within the spray tank or biological effects. Biological incompatibility (antagonism) may result from interactions between herbicides resulting in poorer weed control than when the herbicides are separately applied. Figures 4 and 5 show that the glyphosate composition of the invention exhibits a high compatibility rate when compared with other high rate glyphosate compositions. Figure 4 compares the invention with prior art when each are used with a commercial Trifluralin composition. Figure 5 compares composition of the invention with the prior art when used with commercial atrazine formulation.

It is to be understood that the invention described herein above is susceptible to variations, modifications and/or additions other than those specifically described and that the invention includes all such variations, modifications and/or additions which fall within the spirit and scope of the above description.

Claims:

1. An adjuvant composition for use with a herbicide including:
one or more agriculturally acceptable salts;
a surfactant component including an ammonium salt of an ethoxylated
5 alcohol phosphate ester; and
an amphoteric surfactant.
2. An adjuvant composition according to claim 1 wherein the agriculturally
acceptable salt is selected from the group consisting of ammonium sulphate,
10 alkylammonium sulphate, ammonium nitrate, potassium phosphate,
tetrapotassium pyrophosphate, sodium trisulphate, sodium sulphate and
ammonium bicarbonate.
3. An adjuvant according to claim 1 wherein the one or more agriculturally
15 acceptable salts include a sulphate selected from ammonium sulphate,
alkylammonium sulphate or mixture thereof.
4. An adjuvant according to claim 1 including:
from 5 to 30% w/w of a sulphate selected from ammonium sulphate,
20 alkylammonium sulphate and mixture thereof;
from 0.5 to 25% w/w of ammonium salt of an ethoxylated alcohol
phosphate ester; and
from 0.5 to 10% by w/w of amphoteric surfactant.
- 25 5. An adjuvant according to claim 4 wherein the amphoteric surfactant is a
phospholipid.
6. An adjuvant composition according to claim 1 for use as a tank mix
adjuvant which is free of active herbicidal compound.
- 30 7. A herbicidal composition containing one or more herbicides and an
adjuvant component according to any one of the previous claims.

8. A herbicidal composition according to claim 6 wherein one or more herbicides are selected from the group consisting of glyphosate, a dinitroaniline herbicide, a triazine herbicide, a cyclohexanedione oximeherbicide, a phenoxy herbicide, an imidazoline herbicide and a pyridyloxyphenoxy herbicide.

9. A herbicidal composition according to claim 7 wherein the herbicide is a glyphosate herbicide including a mixture of the ammonium salt of glyphosate and the isopropylamine salt of glyphosate.

10

10. A herbicidal composition according to claim 9 wherein the weight ratio based on glyphosate acid of said isopropylamine salt to said ammonium salt is in the range of from 80:20 to 97:3.

11. A kit for preparing a herbicidal composition including a herbicide and an adjuvant for the herbicide including an ethoxylated alcohol phosphate ester wherein when equivalent volumes of the herbicide and adjuvant are mixed the mixture contains a weight ratio of herbicidal active to ethoxylated alcohol phosphate ester surfactant in the range of from 150:1 to 3:1.

20

12. A kit according to claim 10 wherein the herbicide is a glyphosate herbicide and the weight ratio is determined on the basis of weight of glyphosate acid.

13. A method of eradicating weeds including mixing a herbicide formulation with an adjuvant according to any one of claims 1 to 6 and applying the mixture to the weeds.

14. A method according to claim 13, wherein the mixture is diluted with water before applying the mixture to the weeds.

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15. A method according to claim 12 wherein the herbicide is a glyphosate herbicide comprising a mixture of the monoisopropylamine salt of glyphosate and the ammonium salt of glyphosate wherein the ratio of glyphosate in
5 monoisopropylamine salt form to ammonium salt form is in the range of from 80:20 to 97:3 based on glyphosate acid.

Figure 1

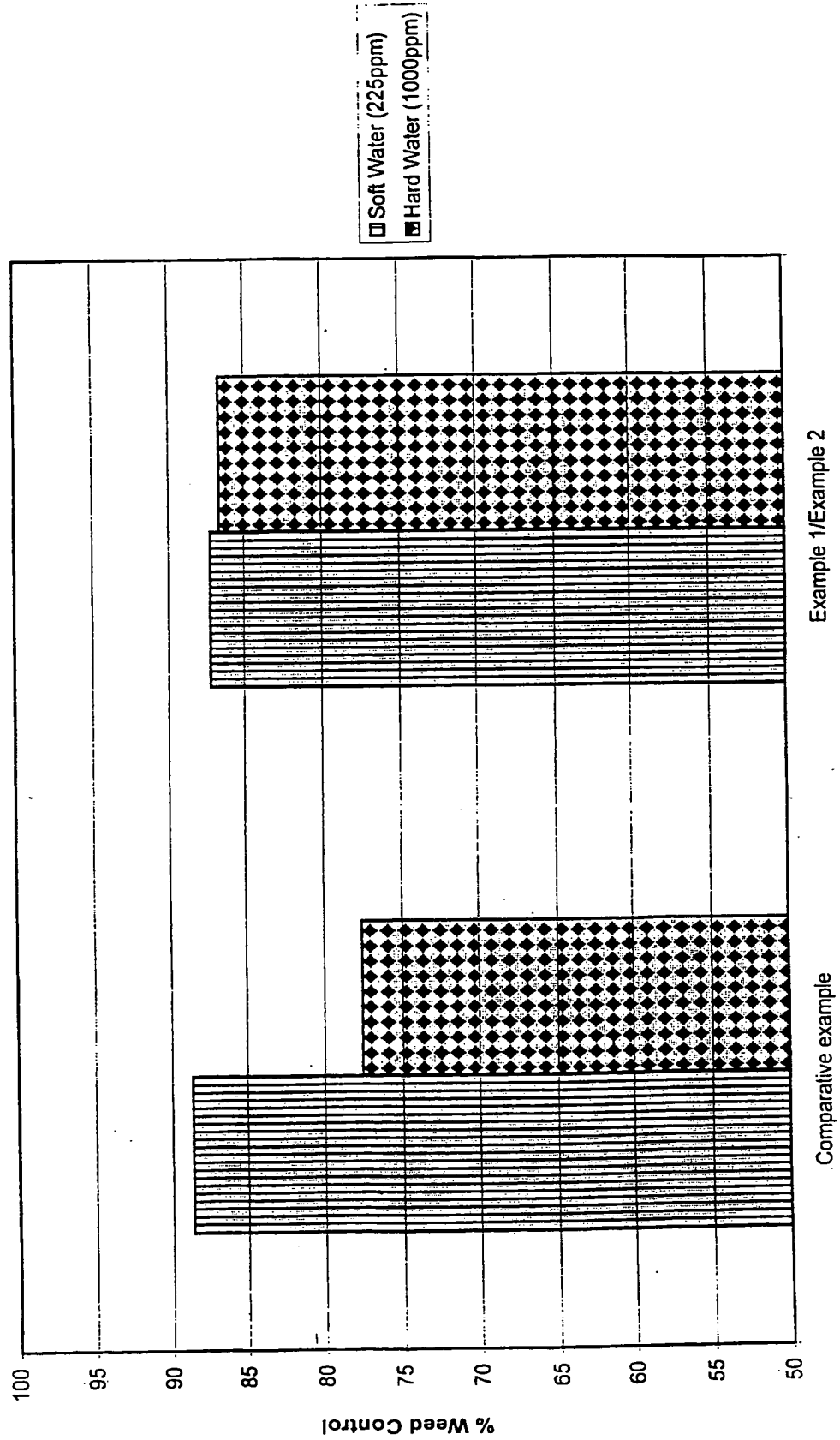


Figure 2

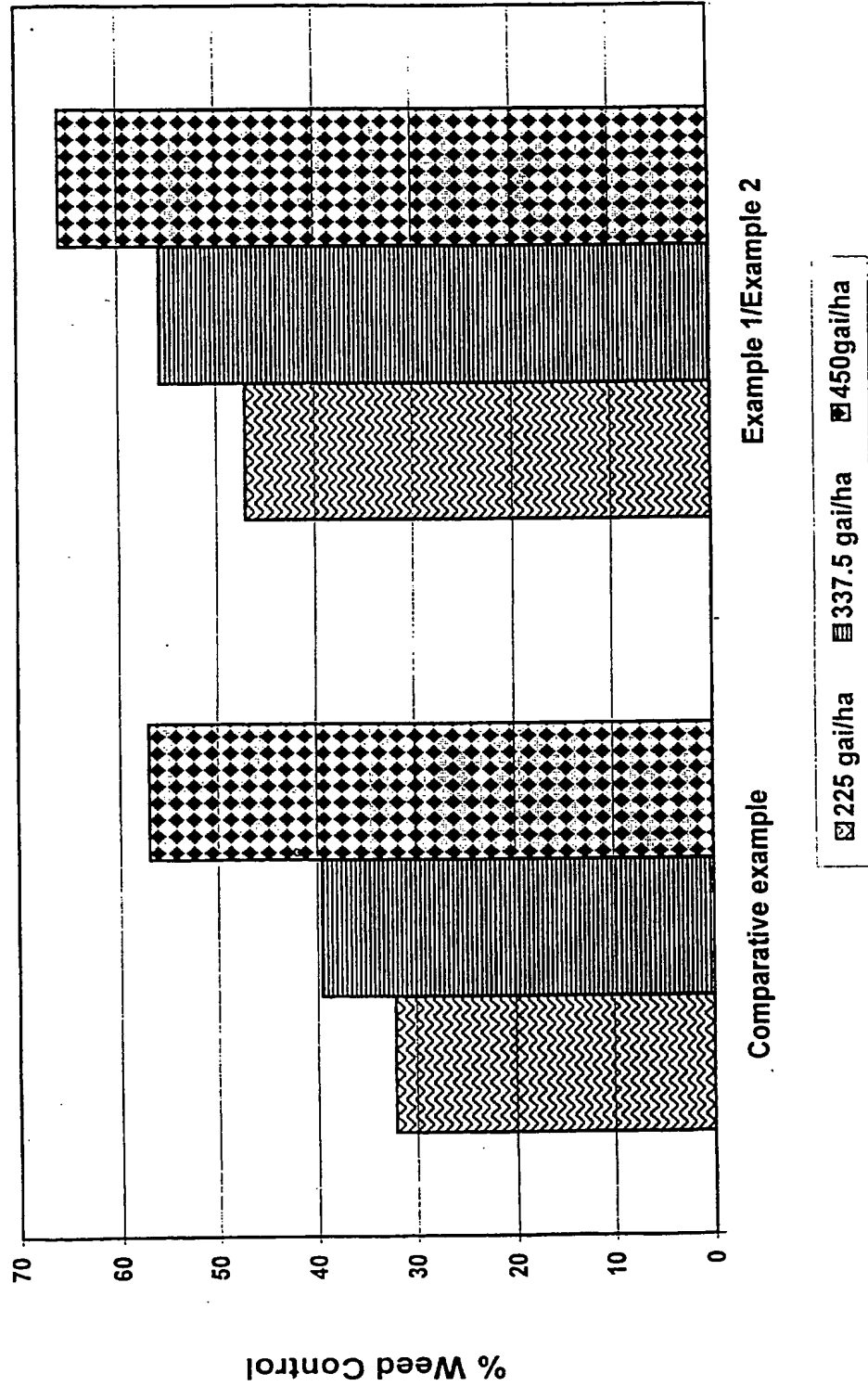


Figure 3

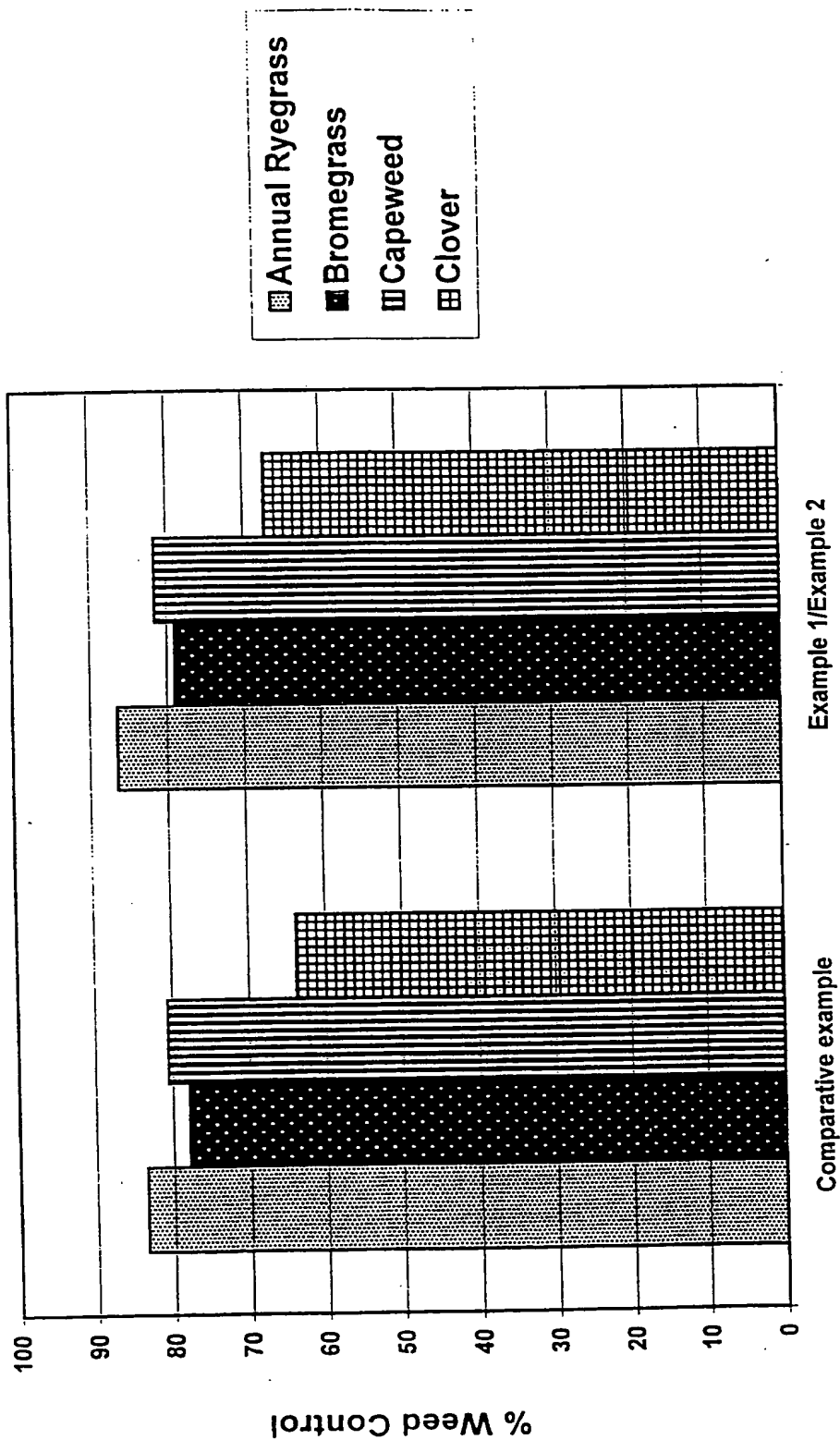


Figure 4
Weeds - Annual Ryegrass, Bromegrass, Capeweed, Clover

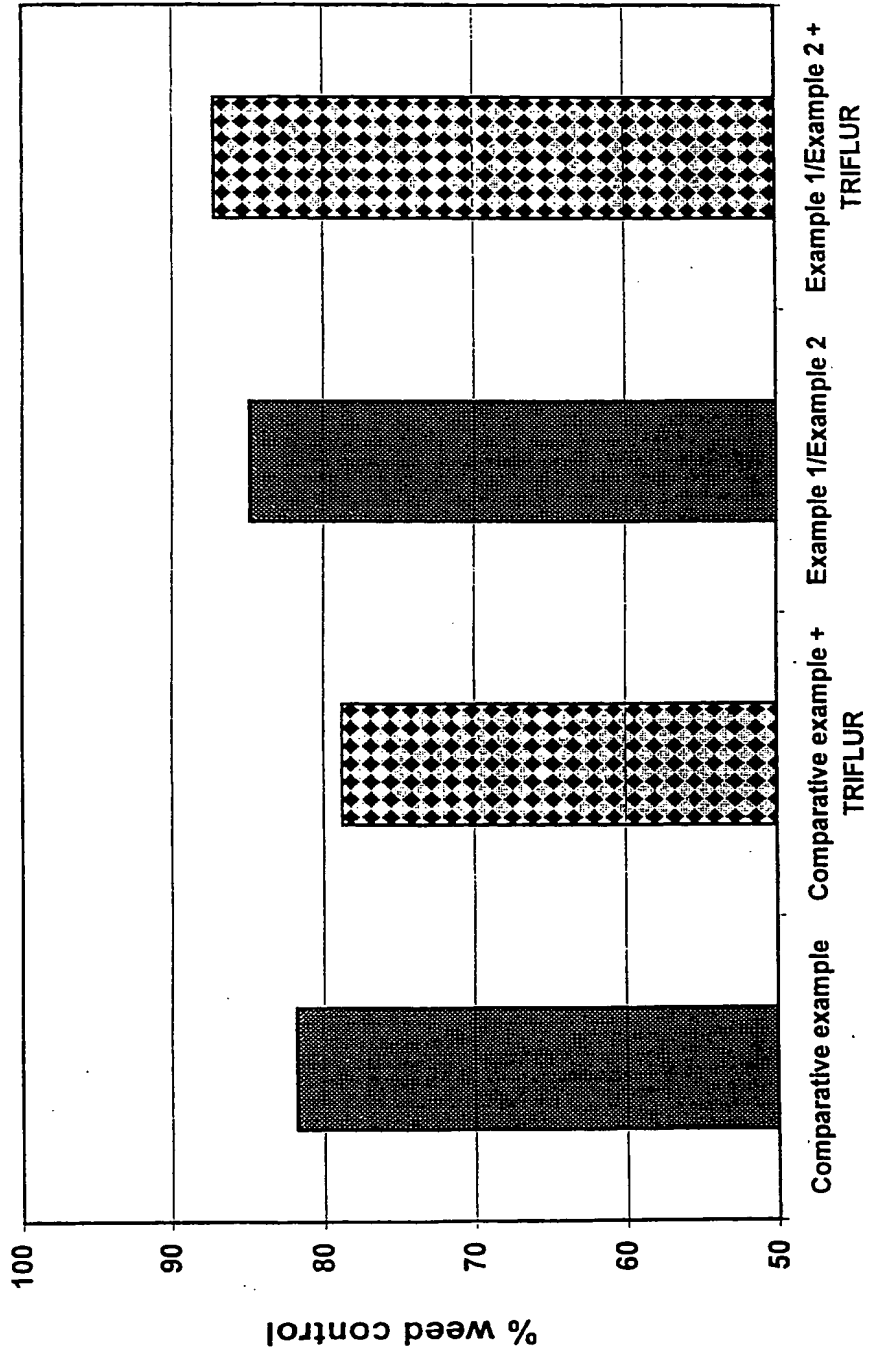
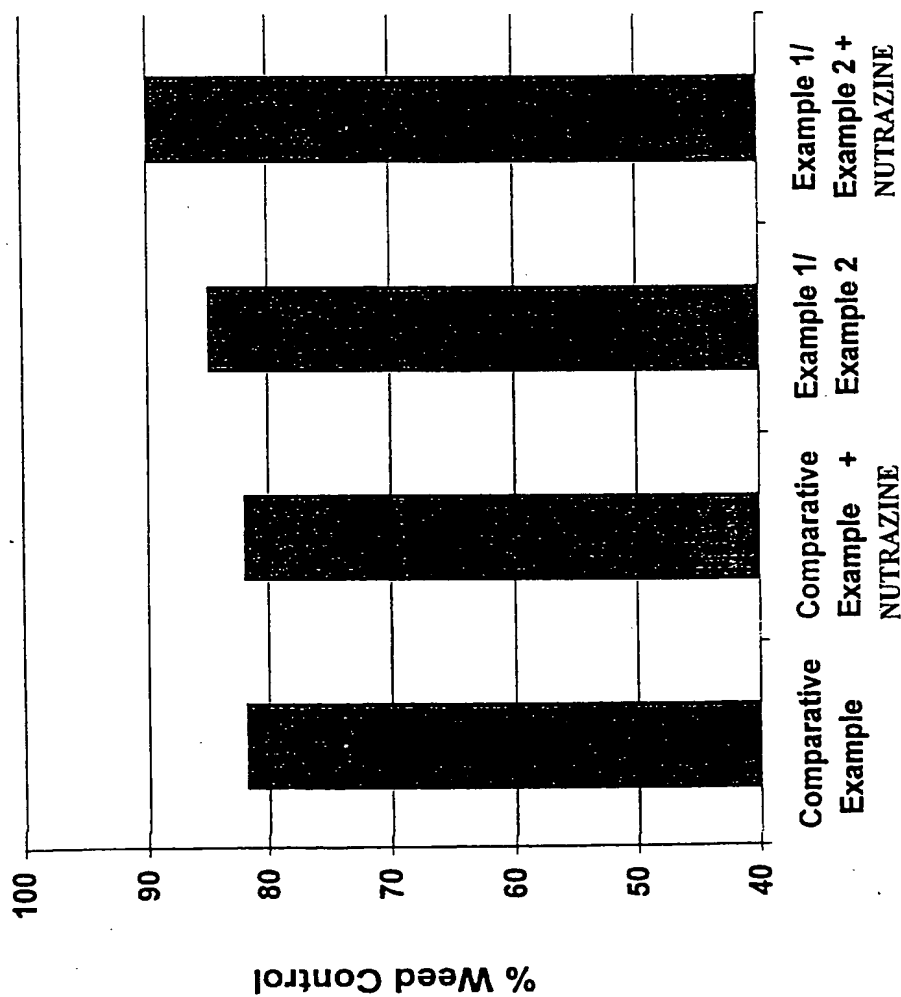


FIGURE 5
Glyphosate Compatibility with Nutrazine
 Weeds - Annual Ryegrass, Bromegrass, Capeweed, Clover



INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU00/00284

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl. ⁷: A01N 25/30

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC: A01N 25/30

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
WPAT : IPC and ammonium

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5,877,112 A (ROBERTS et al.) 2 March 1999 Whole document	1-4,6-15
Y	EP 483,095 A (MONSANTO COMPANY) 29 April 1992 Whole document	1-4,6-15
Y	US 5,912,209 A (KASSEBAUM et al.) 15 June 1999 Whole document	1-4,6-15

☒ Further documents are listed in the continuation of Box C ☒ See patent family annex

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- "A" document defining the general state of the art which is not considered to be of particular relevance
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- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed
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- "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
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INTERNATIONAL SEARCH REPORT

International application No.

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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5,180,414 A (DARCHY et al.) 19 January 1993 Whole document	1-4,6-15

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/AU00/00284

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report				Patent Family Member			
EP	483095	AU	85546/91	NZ	240081		
US	5912209	AU	12137/95	BR	9408327	CA	2179192
		EP	734206	NZ	277191	WO	9516351
US	5180414	AT	1040/91	AU	77131/91	BE	1005378
		CA	2042348	DE	4116516	DK	931/91
		ES	2035773	FR	2662053	GB	2245170
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